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CASE REPORT

A case of delayed hemothorax with an inferior phrenic artery injury detected and treated endovascularly

Keiji Yamanashi[1,2], Shota Nakao[1], Koji Idoguchi[1] & Tetsuya Matsuoka[1]

[1]Osaka Prefectural Senshu Critical Care Medical Center, Izumisano, Osaka, Japan
[2]Department of Thoracic Surgery, Tazuke Kofukai Foundation, Medical Research Institute, Kitano Hospital, Osaka, Japan

Correspondence
Keiji Yamanashi, Department of Thoracic Surgery, Tazuke Kofukai Foundation, Medical Research Institute, Kitano Hospital, 2-4-20 Ohgimachi, Kita-ku, Osaka, 530-8480, Japan.
Tel: +81 6 6361 0588, Fax: +81 6 6312 8620,
E-mail: jiike6180@yahoo.co.jp

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Key Clinical Message

We report the rare case of delayed hemothorax (DHX) with an inferior phrenic artery (IPA) injury due to blunt thoracic trauma. Our case suggests that DHX almost always occurs early after injury, and endovascular treatment is an effective procedure for traumatic hemothorax including DHX.

Keywords

Blunt thoracic trauma, delayed hemothorax, endovascular treatment, inferior phrenic artery.

Background

Delayed hemothorax (DHX) occurs infrequently after blunt thoracic trauma, and its incidence reportedly ranges from 4.2% to 7.4% [1, 2]. It results from an injury involving various arteries in the thoracic space. In recent reports on patients with DHX, the bleeding source was the intercostal artery in most cases [3, 4]. We report the rare case of DHX with an inferior phrenic artery (IPA) injury due to blunt thoracic trauma, which was detected and treated endovascularly.

Case Presentation

A 75-year-old man was transported to our hospital after a motorcycle accident, and he sustained severe blunt trauma to the right side of the chest. The oxygen saturation was 98% with a low-flow oxygen supply. His hemoglobin was 9.5 g/dL, pH was 7.43, PaO_2 was 122.2 mmHg, and $PaCO_2$ was 30.0 mmHg.

Chest radiography showed a right pneumothorax with a mediastinal shift (Fig. 1A). He underwent right chest drainage and about 30 mL of bloody discharge was drained. After releasing the pneumothorax (Fig. 1B), chest contrast-enhanced computed tomography (CT) showed right lateral displaced fractures of ribs 7 and 8 and posterior displaced fractures of ribs 10 and 11, a small right hemorrhagic pleural effusion, and no extravasation of the contrast agent around the thoracic space (Fig. 1C). Abdominal contrast-enhanced CT showed a liver injury (American Association for the Surgery of Trauma grade III) with extravasation of the contrast agent and ascites around the liver (Fig. 1D). Therefore, endovascular treatment was performed. The contrast agent leak arose from the A5 branch of the anterior segmental artery, and it was embolized using a gelatin sponge. On the first day after admission, the chest tube discharge was serous (flow rate, 5 mL/h); however, after 24 h from admission, it suddenly became bloody (flow rate, 250 mL/h). Emergency angiography was performed, because chest contrast-enhanced CT showed a massive pleural effusion and extravasation of the contrast agent in the chest wall near the crus of the diaphragm (Fig. 2A); additionally, the chest tube discharge was

bloody and massive, and anemia had progressed (the hemoglobin decreased from 9.1 to 6.9 g/dL). The contrast agent leak arose from the right IPA, and a pseudoaneurysm was detected (Fig. 2B). After the right IPA was embolized using a gelatin sponge, selective angiography of the celiac artery confirmed complete occlusion of the artery and no contrast agent leak (Fig. 2C). On the 21st day postembolization, chest contrast-enhanced CT showed the persistence of a right pleural effusion, a large retained hemothorax on the diaphragm, and a collapsed right lower lobe even though an additional right intercostal tube drain was inserted in the diaphragm (Fig. 2D). *Klebsiella pneumoniae* was isolated from the pleural fluid specimens. Thus, video-assisted thoracic surgery debridement was performed. Intraoperative views showed a thickened and fragile capsule covering the huge hematoma (Fig. 2E). After debridement and intrapleural large-bore lavage, we confirmed that there was no active bleeding in the observation region.

Outcome and Follow-up

The patient remains alive after a month with no sign of hemothorax and empyema recurrence.

Discussion

DHX occurs infrequently after blunt thoracic trauma, and its incidence reportedly ranges from 4.2% to 7.4% [1, 2]. Sharma et al. reported that DHX occurs between 22 h and 16 days, and it was diagnosed within 4 days in 86% of patients [1]. However, why does DHX occur after blunt thoracic trauma? DHX patients usually have multiple displaced rib fractures [1, 3], and Ross et al. reported on the onset of DHX. It was temporally related to coughing and a maximum ventilatory maneuver associated with a nebulizer breathing treatment [4], which may cause damage of the artery due to the sharp edges of broken ribs. In our case, there were multiple displaced rib fractures, which could have torn the right IPA.

In recent reports on patients with DHX, the bleeding source was a torn intercostal artery associated with multiple displaced rib fractures in most cases [3, 4]. There have been many reported cases of DHX with associated injuries to the diaphragm [1, 5, 6]; however, the case of DHX due to an IPA injury that was detected by angiography is rare.

The following discusses possible reasons why hemothorax, including DHX, occurs after an IPA injury. The typical course of the right and left IPA is as follows: each artery crosses the crus of the diaphragm and courses

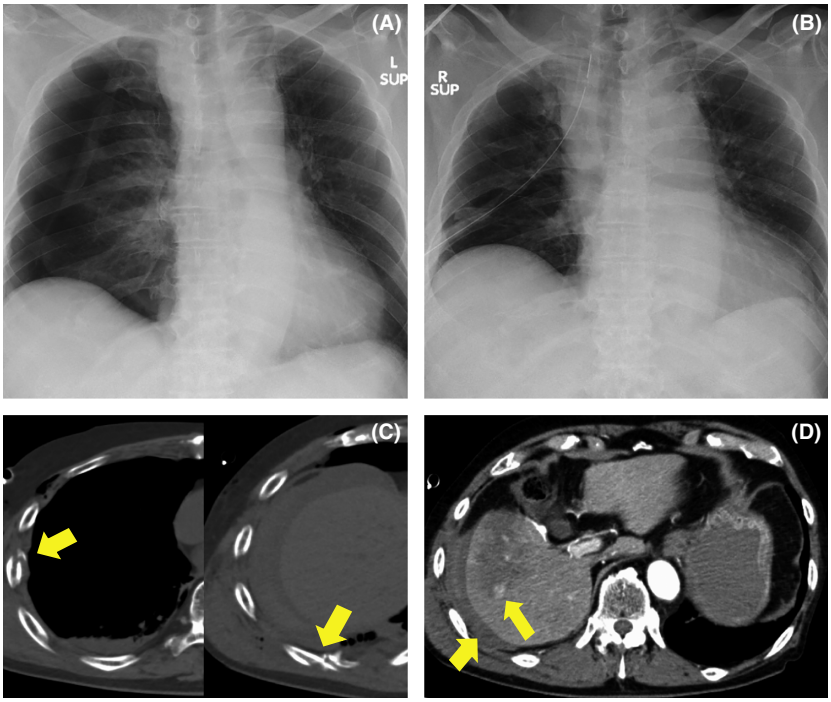

Figure 1. (A) Chest radiograph showing a right pneumothorax with a mediastinal shift and (B) a released pneumothorax after an intercostal tube drain is inserted. (C) Chest contrast-enhanced computed tomography (CT) scan showing right lateral and posterior displaced rib fractures and a small right hemorrhagic pleural effusion. (D) Abdominal contrast-enhanced CT scan showing a hypodense lesion in the right liver lobe with extravasation of the contrast agent and ascites around the liver.

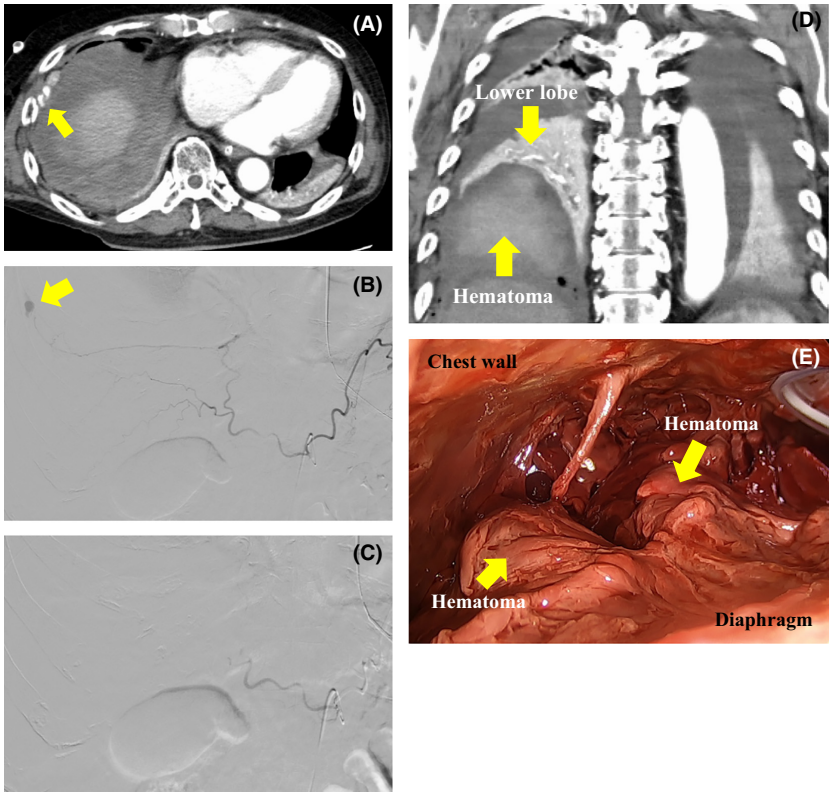

Figure 2. (A) Chest contrast-enhanced computed tomography (CT) scan showing a massive pleural effusion and extravasation of the contrast agent in the chest wall near the crus of the diaphragm. (B) A contrast agent leak is arising from the right inferior phrenic artery (IPA) and pseudoaneurysm, and (C) selective angiography of the celiac artery confirms a complete occlusion of the right IPA and no leak of the contrast agent after embolization. (D) Chest contrast-enhanced CT showing a right hemorrhagic pleural effusion and the collapsed right lower lobe. (E) Intra-operative views showing a thickened and fragile capsule covering the huge hematoma.

laterally in an oblique direction on the abdominal surface of the diaphragm [7]. Accordingly, if the IPA is damaged, intraperitoneal hemorrhage occurs anatomically. The right and left IPA branches supply the muscle of the inferior surface of the diaphragm and anastomose with the musculophrenic and pericardiacophrenic arteries [7]; therefore, it is conceivable that the right and left IPA branches run into the muscle of the diaphragm and near the thoracic surface of the diaphragm. Ogawa et al. reported on a case of hemothorax due to a left IPA branch injury, which was detected by angiography and thoracotomy [8]. In that case, the thoracic surface of the diaphragm was damaged from bleeding of the left IPA branch. Thus, in our case, it is expected that the right IPA branch was damaged by a similar mechanism and an intrathoracic hemorrhage occurred, not an intraperitoneal hemorrhage.

The treatment of DHX includes treating it like a traumatic hemothorax. Contrast-enhanced CT is generally considered necessary for identifying all the bleeding points, documenting their anatomic relationships, and detecting extravasation of the contrast agent or pseudoaneurysms [9]. In recent reports, endovascular treatment is a more effective procedure for identifying the origin of bleeding into the thoracic space than thoracotomy, and transcatheter arterial embolization is commonly considered the most reliable and feasible therapeutic alternative to thoracotomy for controlling intrathoracic arterial hemorrhage [8, 10, 11]. Moreover, Carrillo et al. reported on the morbidity associated with thoracotomy, coupled with the frustratingly low likelihood of finding the source of hemorrhage in some patients, making selective angiography and transcatheter embolization a less invasive, more accurate, and reliable method for treatment [11]. In our case, the bleeding point was identified by extravasation of the contrast agent on chest contrast-enhanced CT, and endovascular treatment was performed.

Although patients with retained pleural collections should be managed with further surgical interventions to prevent complications such as empyema and fibrothorax [12, 13], surgical intervention is not always appropriate; in our case, we considered the risk of right IPA rebleeding and did not perform surgical intervention. As a result,

video-assisted thoracic surgery debridement was performed because of empyema, and we confirmed that there was no rebleeding in the thoracic space. Thus, in our case, endovascular treatment was an effective procedure for controlling the intrathoracic arterial hemorrhage.

Frequent follow-up for patients with blunt thoracic trauma is necessary, because DHX almost always occurs early after injury. In the case of traumatic hemothorax, including DHX, endovascular treatment is an effective procedure for identifying the origin of bleeding in the thoracic space and for performing selective embolization, which is an alternative to thoracotomy for controlling intrathoracic arterial hemorrhages.

Conflict of Interest

None declared.

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